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EM RADIOLOGICAL GUIDELINES

Rocky Flats Environmental Technology Site

4-P12-ER-OPS-EMRG-6.7

REVISION 0

PERFORMANCE CHECKING AND OPERATION OF LUDLUM SMEAR COUNTING INSTRUMENTS

APPROVED BY: M.C. Broussard | M.C. BROUSSARD | 3-16-95

Operations Manager, Environmental Operations Management — Print Name — Date

[signature] | R S LUKER | 3/15/95

Quality Assurance Manager, Data Management and Reporting Services — Print Name — Date

DOE RFFO/ER Concurrence on file: ☐ Yes ☐ No ☑ NA

Environmental Protection Agency Approval Received: ☐ Yes ☐ No ☑ NA

Responsible Organization: Environmental Restoration Program Division Effective Date: 4/7/95 for D.G.D. SLD

CONCURRENCE BY THE FOLLOWING DISCIPLINES WILL BE DOCUMENTED IN THE PROCEDURE HISTORY FILE:
Data Management & Reporting Services
Environmental Operations Management
Radiological Health and Engineering
Industrial Hygiene.

USE CATEGORY 3

ORC review not required

The following have been incorporated in this revision:
94-DMR-001669

Periodic review frequency: 3 years from the effective date

LIST OF EFFECTIVE PAGES

Pages	Effective Date	Change Number
1-16	4/7/~~94~~95 SLD	94-DMR-001669

TOTAL NUMBER OF PAGES: 16

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1. PURPOSE

This procedure provides the requirements for performance testing and operation of the Ludlum models 1000 and 2000 with the 43-10 detector alpha scintillation smear counting instruments, the Ludlum model 2000 with the 44-1 probe, and the alpha and beta channels of the Ludlum model 2929 with the 43-10-1 dual detector.

This procedure implements the requirements of the following:

- DOE/EH-0256T, Radiation Control Manual
- DOE Order 5400.5, Radiation Protection of the Public and the Environment

2. SCOPE

This procedure applies to the Rocky Flats Environmental Technology Site subcontractors involved in the preparation, administration, execution, and modification of radiological guidance.

This procedure addresses the following topics:

- Ludlum Models 1000, 2000, and 2929 - Alpha Background Count Rate
- Ludlum Models 1000, 2000, and 2929 - Alpha Performance Check
- Ludlum Models 2000 and 2929 - Beta Background Count Rate
- Ludlum Models 2000 and 2929 - Beta Performance Check
- Servicing of Counting Instruments
- Operation of the Alpha-scintillation counting instrument
- Operation of the Beta Smear Counting Instrument

This revision is a total rewrite and revision bars are omitted.

3. OVERVIEW

Ludlum smear counters are intended to quantify removable alpha and beta/gamma contamination. The Ludlum Models 1000 and 2000 are used for alpha counting while the Model 2929 has the ability to count both alpha and beta/gamma.

The Ludlum Model 1000 is an alpha scintillation smear counting instrument. The Model 1000 operates on 110 VAC line power and is intended for stationary laboratory usage only.

The Ludlum Model 2000 is a self-contained counting instrument designed for operation with scintillation, proportional, or G-M detectors. It is powered by four D cell batteries or 110 VAC line power. A battery charger is built in for rechargeable cells. The unit is complete with a voltage-sensitive preamplifier, linear amplifier, electronic timer, and detector high-voltage power supply. Model 2000 is intended for field or laboratory use.

3. OVERVIEW (continued)

The Ludlum Model 2929 is a Dual Channel Scaler designed for use with "Phoswich" or proportional detectors. A pulse height analyzer is employed to provide information to the two independent counters. Model 2929 is powered by 110 VAC and has a 6-digit front panel LED readout and a click per event audio with volume control for each of the two channels. The Model 2929 is intended for laboratory use only.

4. RESPONSIBILITIES

4.1 Environmental Restoration Health and Safety Specialist (HSS)

Performs background count rate determinations for Ludlum Models 1000, 2000, and 2929 prior to operation in accordance with Section 5.1, Ludlum Models 1000, 2000, and 2929 - Alpha Background Count Rate.

Performs alpha performance checks for Ludlum Models 1000, 2000, and 2929 prior to operation in accordance with Section 5.2, Ludlum Models 1000, 2000, and 2929 - Alpha Performance Check.

Performs beta background count rate determinations for Ludlum Models 2000 and 2929 prior to operation in accordance with Section 5.3, Ludlum Model 2929 - Beta Background Count Rate.

Performs beta performance checks for Ludlum Models 2000 and 2929 prior to operation in accordance with Section 5.4, Ludlum Model 2929 - Beta Performance Check

Ensures calibration facilities meet the requirements of American National Standards Institute (ANSI) N323-1978, Radiation Protection Instrumentation Test and Calibration, for instruments not calibrated on site. This may be satisfied by the calibration sheet statement that the lab meets ANSI N323-1978.

Completes Appendix 1, Instrument Performance Check Logs after the pre-operational performance, or background count rate checks.

Refers servicing of counting instruments to certified calibration facilities, the equipment vendor, or equipment owners when servicing is required.

Determines contamination by counting smears taken in accordance with 3–P11–ER–OPS–EMRG–3.1, Performance of Surface Contamination Surveys.

Ensures that all personnel, including subcontractors, are trained and qualified to perform the duties, tasks, and responsibilities described in this procedure.

Ensures that all core and Enviromental Restoration Program Division specific training has been completed and documented, and that copies of all documentation have been forwarded to the Environmental Restoration Program Division training Files.

5. LIMITATIONS AND PRECAUTIONS

- Prior to use of counting instruments on each shift, the average background count rate shall be determined and performance test conducted.
- Calibration sticker shall be verified to be current before the operation of each instrument.
- Caution must be observed in order to prevent contamination of instruments while placing smears in the counter.
- Prior to use, ensure that all necessary source checks have been performed.
- Equipment warm up times required by the manufactures' specifications shall be met prior to use.

6. PREREQUISITES

HSS

[1] Verify by visual inspection that the calibration due date of the instrument being used has not expired.

[2] **IF** the calibration due date has passed,
THEN refer the instrument to a certified calibration facility, the equipment vendor, or the owner for servicing.

[3] Inspect the instrument for any physical damage that could affect its operation.

[4] **IF** instrument is found to have physical damage that could affect its operation,
THEN:

[A] notify the Subcontractor Site Safety Officer (SSO)

[B] remove the instrument from service

[C] obtain another instrument

[D] go to step [1] above

[5] Obtain the latest Instrument Performance Check Log for the instruments to be used, or make a copy of Appendix 1, Instrument Performance Check Log.

This form will be used to record the performance check for the equipment being used.

7. INSTRUCTIONS

7.1 Ludlum Models 1000, 2000, and 2929 - Alpha Background Count Rate

HSS

[1] Verify that all prerequisite actions have been completed.

[2] Record the following information, for the instrument being used on the Instrument Performance Check Log:

- Type
- Serial number (#)
- Calibration due (date)

[3] **IF** a Ludlum Model 2000 instrument is being used,
THEN perform a battery check.

[4] Ensure that instrument power has been turned on for a minimum of 10 min. before use.

[5] Open the sample drawer and carefully wipe the top of the drawer and planchet area using cotton swabs or Kimwipes® moistened with alcohol.

[6] Place a clean smear on the sample tray with tweezers ensuring the smear remains flat in the sample tray.

[7] Close and lock the drawer to the sample tray.

[8] Set the control switches of the counter as follows:

[A] Set POWER to ON.

[B] Set MINUTE to 1 minute.

[C] Set MULTIPLIER to the x10 position.

[D] Set COUNT MODE to the TIMED position.

[9] Press START/RESET.

The counting lamp will illuminate.

[10] Determine the average background count rate by dividing the total count by 10.

[11] **IF** the average background count rate is less than 1 count per minute (cpm),
THEN record the value in the Background Count Rate column of the Instrument Performance Check Log.

[12] Record the time that the background count rate was taken in the space provided on Instrument Performance Check Log.

7.1 Ludlum Models 1000, 2000, and 2929 - Alpha Background Count Rate (continued)

HSS

[13] **IF** the first average background count rate is equal to or greater than 1 cpm, **THEN** repeat Steps [6] through [13].

[14] **IF** the second average background count rate is equal to or greater than 1 cpm, **THEN** do **NOT** use the instrument and notify the Environmental Restoration Subcontractor Site Safety Officer (SSO).

7.2 Ludlum Models 1000, 2000, and 2929 - Alpha Performance Check

HSS

[1] Ensure that an alpha background count rate has been determined in accordance with Section 7.1.

[2] Obtain a National Institute of Standards and Technology (NIST) certified Th-230 or Pu-239 alpha source for the performance of the Alpha Performance Check.

[3] Verify that the source has a current calibration label.

[4] Ensure that the source value is greater than 1500 disintegrations per minute (dpm).

[5] Record the following information, for the source being used, on the Instrument Performance Check Log:

- Isotope
- Identification (ID) number (#)
- Certified activity (dpm)

[6] **IF** a Ludlum Model 2000 instrument is being used, **THEN** perform a battery check.

[7] Ensure that instrument power has been turned on for a minimum of 10 min. before use.

NOTE *The alpha source must be placed in the sample drawer with the source activity side up.*

[8] Open the sample drawer and carefully place the alpha source, with the source activity side up, in the middle of the sample holder.

[9] Close and lock the sample drawer.

7.2 Ludlum Models 1000, 2000, and 2929 - Alpha Performance Check (continued)

HSS

[10] Set the control switches as follows:

[A] Set POWER to ON.

[B] Set MINUTE to 1 minute.

[C] Set MULTIPLIER to the x1 position.

[D] Set COUNT MODE to the TIMED position.

[11] Press START/RESET and the counting lamp will illuminate.

[12] **WHEN** the counting lamp is no longer illuminated,
THEN record the cpm on the Instrument Performance Check Log.

[13] Determine the percent error of the observed counts compared to the source standard value per the following formula:

$$\% \text{ Error} = \frac{(\text{cpm} / \text{efficiency}) - \text{Certified Activity (dpm)}}{\text{Certified Activity (dpm)}} \times 100$$

Efficiency is obtained from the instrument calibration certification sheet.

[14] Record the percent error on the Instrument Performance Check Log.

[15] Review the results of the Instrument Performance Check prior to use each shift.

[16] Verify the percent error is within the ± 20% range.

[17] **IF** the percent error falls outside the ± 20% range,
THEN:

[A] do **NOT** use the instrument

[B] notify the SSO

[18] Remove the source from the sample holder.

[19] **IF** no other source checks are being performed at this time,
THEN return the source to the designated storage location.

7.3 Ludlum Models 2000 and 2929 - Beta Background Count Rate

HSS

[1] Verify that all prerequisite actions have been completed.

[2] Record the following information, for the instrument being used, on the Instrument Performance Check Log:

- Type
- Serial number (#)
- Calibration due (date)

[3] **IF** a Ludlum Model 2000 instrument is being used,
THEN perform a battery check.

[4] Ensure that instrument power has been turned on for a minimum of 10 min. before use.

[5] Open the sample drawer and carefully wipe the top of the drawer and planchet area using cotton swabs or kimwipes moistened with alcohol.

[6] Place a clean smear on the sample tray with tweezers ensuring the smear remains flat in the sample tray.

[7] Close and lock the drawer to the sample tray.

[8] Set the control switches of the counter as follows:

[A] Set POWER to ON.

[B] Set MINUTE to 10 minutes.

[C] Set MULTIPLIER to the x1 position.

[D] Set COUNT MODE to the TIMED position.

[9] Press START/RESET the counting lamp will illuminate.

[10] Determine the average background count rate by dividing the total counts by 10.

[11] **IF** the background count rate is between 50 and 125 cpm for model 2929
OR between 20 and 70 cpm for model 2000,
THEN record the value in the Background Count Rate column on Appendix 1.

[12] Record the time of the background determination in the space provided on the Instrument Performance Check Log.

[13] **IF** the background count rate is outside the range of 50 to 125 cpm for model 2929
OR 20 to 70 cpm for model 2000,
THEN repeat Steps [6] through [12]

7.3 Ludlum Models 2000 and 2929 - Beta Background Count Rate

HSS

[14] **IF** the background count rate is outside the range of 50 to 125 cpm for model 2929 **OR** 20 to 70 cpm for model 2000 after repeating Steps [6] through [12], **THEN:**

[A] do **NOT** use the instrument

[B] notify the SSO

7.4 Ludlum Models 2000 and 2929 - Beta Performance Check

HSS

[1] Ensure a beta background count rate has been determined in accordance with Section 7.3.

[2] Obtain a NIST certified SrY-90 beta source or another source approved by Radiological Health and Engineering for the Instrument Performance Check.

[3] Verify the source has a current calibration label.

[4] Record the following information, for the source being used, on the Instrument Performance Check Log:

- Isotope
- Identification (ID) number (#)
- Certified activity (DPM)

[5] **IF** a Ludlum Model 2000 instrument is being used, **THEN** perform a battery check.

[6] Ensure that instrument power has been turned on for a minimum of 10 min. before use.

[7] Open the sample drawer and carefully place the beta source in the middle of the sample holder with the activity side up.

[8] Close and lock the sample drawer.

[9] Set the control switches as follows:

[A] Set POWER to ON.

[B] Set MINUTE to 10 minutes.

[C] Set MULTIPLIER to the x1 position.

[D] Set COUNT MODE to the TIMED position.

7.4 Ludlum Models 2000 and 2929 - Beta Performance Check (continued)

HSS

[10] Press START/RESET.

The counting lamp will illuminate.

[11] **WHEN** the counting lamp no longer illuminates,
THEN record the cpm in the Source Count Rate column in the Instrument Performance Check Log.

[12] Determine the percent (%) error of the observed counts compared to the source standard value per the following formula:

$$\% \text{ Error} = \frac{(\text{cpm} / \text{efficiency}) - \text{Certified Activity (dpm)}}{\text{Certified Activity (dpm)}} \times 100$$

Efficiency is obtained from the instrument calibration certification sheet.

[13] Record the percent error on the Instrument Performance Check Log.

[14] Review the Instrument Performance Check Log each shift.

[15] Verify that the percent error is within the ± 20% range.

[16] **IF** the percent error falls outside the ± 20% range,
THEN:

[A] notify the SSO

[B] do **NOT** use the instrument

[17] Remove the source from the sample holder.

[18] **IF** no other source checks are being performed at this time,
THEN return the source to the designated storage location.

7.5 Operation of Ludlum Models 1000, 2000, and 2929 - Alpha-Scintillation Counting Instruments

HSS

[1] Verify that all prerequisite actions have been completed.

[2] **IF** a Ludlum Model 2000 instrument is being used,
THEN perform a battery check.

[3] Ensure that instrument power has been turned on for a minimum of 10 min. before use.

[4] Ensure that the alpha counter has been source checked for the day that it is being used.

7.5 Operation of Ludlum Models 1000, 2000, and 2929 - Alpha-Scintillation Counting Instruments (continued)

HSS

NOTE *One min. counts will be obtained for routine smear counts unless a longer count time is directed by the SSO or Radiological Engineering.*

[5] Set the control switches of the counter as follows:

[A] Set POWER to ON.

[B] Set MINUTE to 1 minute.

[C] Set MULTIPLIER to the x1 position.

[D] Set COUNT MODE to the TIMED position.

[6] Pull the sample drawer open until fully extended and place the smear to be evaluated in the center of the sample holder, activity side up.

[7] Ensure that the sample is as flat as possible to prevent contamination of the detector window.

[8] Carefully close and lock the sample drawer.

[9] Press START/RESET.

The instrument will count for the preset time. At the end of the count time, the instrument readout will display gross counts.

[10] Record the cpm and all required information on the Alpha and Beta-Gamma Contamination Survey Form in accordance with 3-P11-ER-OPS-EMRG-3.1, Performance of Surface Contamination Surveys.

[11] Open the sample drawer and dispose of the smear into an appropriate waste receptacle.

7.6 Operation of Ludlum Models 2000 and 2929 - Beta Smear Counting Instruments

HSS

[1] **IF** a Ludlum Model 2000 instrument is being used,
THEN perform a battery check.

[2] Ensure that the instrument has been turned on for a minimum of 10 min. before use.

[3] Ensure that the dual counter has been source checked for the day that it is being used.

NOTE *One min. counts will be obtained for routine smear counts unless a longer count time is directed by the SSO or Radiological Engineering.*

[4] Set the control switches of the counter as follows:

[A] Set POWER to ON.

[B] Set MINUTE to 1 minute.

[C] Set MULTIPLIER to the x1 position.

[D] Set COUNT MODE to the TIMED position.

[5] Pull the sample drawer open until fully extended and place the smear to be evaluated in the center of the sample holder, activity side up.

[6] Ensure the sample is as flat as possible to prevent contamination of the detector window.

[7] Carefully close and lock the sample drawer.

[8] Press START/RESET.

The instrument will count for the preset time. At the end of the count time, the instrument readout will display gross counts.

[9] Determine the dpm value for the smear using the following formulas:

[A] cpm (net) = cpm gross – cpm background

[B] $$\text{dpm} = \frac{\text{cpm (net)}}{\text{instrument efficiency}}$$

[10] Record the dpm smear value and all information on the Alpha and Beta-Gamma Contamination Survey Form in accordance with 3-P11-ER-OPS-EMRG-3.1.

[11] Open the sample drawer and dispose of the smear into an appropriate waste receptacle.

[12] Repeat Steps [4] through [11] for all smears to be counted.

7.7 Servicing Of Counting Instruments

HSS

[1] Ensure that any calibration facility meets the requirements of American National Standards Institute (ANSI) N323-1978, Standard for radiation protection instrumentation test and calibration procedure.

[2] Refer servicing of counting instruments to any of the following facilities:

- A certified calibration facility
- The equipment vendor
- The equipment owner

8. RECORDS

Management of all records is consistent with 1-77000-RM-001, Records Management Guidance for Records Sources

HSS

[1] Ensure that the original and one copy of the following quality-related records, as appropriate, are transmitted to the Environmental Restoration Program Division Project File Center in accordance with 2-G18-ER-ADM-17.01, Records Capture and Transmittal:

- Instrument Performance Check Log
- Alpha and Beta-Gama Contamination Survey Form

Submission of record copies to the Environmental Restoration Program Division Project File Center satisfies Administrative Records requirements in accordance with 3-21000-ADM-17.02, Administrative Records Screening and Processing.

There are no nonquality records generated by this procedure.

9. REFERENCES

American National Standards Institute (ANSI) N323-1978, Radiation Protection Instrumentation Test and Calibration

DOE/EH-0256T, Radiation Control Manual

DOE Order 5400.5, Radiation Protection of the Public and the Environment

DOE Order 5480.11, Radiation Protection for Occupational Workers

1-77000-RM-001, Records Management Guidance for Records Sources

3-P11-ER-OPS-EMRG-3.1, Performance of Surface Contamination Surveys

2-G18-ER-ADM-17.01, Records Capture and Transmittal

3-21000-ADM-17.02, Administrative Records Screening and Processing

APPENDIX 1

Page 1 of 1

Instrument Performance Check Log

Instrument
Type _____
Serial # _____
Calibration Due _____

Source
Isotope _____
Activity (DPM) _____
ID # _____

Acceptance Criteria
Percent Error ≤ 20%

Date	Time	Efficiency (cpm/dpm) Note (1)	Source Count Rate (cpm)	Background Count Rate (cpm)	Net Count Rate (cpm) (2)	Observed Activity (cpm) (3)	% Error (≤ 20%?)	Acceptance (Yes/No)	HSS Initials

Note (1) Efficiency is determined during the instruments calibration
Note (2) Net Count Rate = Source Count Rate - Background Count Rate
Note (3) Observed Activity = Net Count Rate ÷ Efficiency

$$\% \text{ Error} = \frac{(\text{cpm} / \text{efficiency}) - \text{Certified Activity (dpm)} \times 100}{\text{Certified Activity (dpm)}}$$

4/6/95

EG&G ROCKY FLATS

ENVIRONMENTAL RESTORATION PROGRAM DIVISION

Document Transmittal Acknowledgement Notice

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Manual No. 3-21000-OPS-EMRG

The following controlled documents are being transmitted to you.

Document No.	Document Title
3-21000-OPS-EMRG, TOC, R7	Table of Contents for the RFP EM Radiological Guidelines
4-P12-ER-OPS-EMRG 6.7, R0	Performance Checking and Operation of Ludlum *Smear Counting Instruments*

Instructions:

1. Please remove TOC, R6 and replace with the enclosed TOC, R7
2. Insert new document 4-P12-ER-OPS-EMRG-6.7, R0

Please acknowledge receipt of the attached and completion of the instructions stated above by signing below and returning this page to Environmental Restoration Technical Publications, EG&G Rocky Flats, P.O. Box 464, Building 080, Golden, CO 80402-0464. Please return by **April 19, 1995**.

Acknowledgement Signature

Date

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Quality Assurance Manager, Data Management and Reporting Services — Print Name — Date

DOE RFFO/ER Concurrence on file: ☐ Yes ☐ No ☑ NA

Environmental Protection Agency Approval Received: ☐ Yes ☐ No ☑ NA

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The Ludlum Model 2929 is a Dual Channel Scaler designed for use with "Phoswich" or proportional detectors. A pulse height analyzer is employed to provide information to the two independent counters. Model 2929 is powered by 110 VAC and has a 6-digit front panel LED readout and a click per event audio with volume control for each of the two channels. The Model 2929 is intended for laboratory use only.

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4.1 Environmental Restoration Health and Safety Specialist (HSS)

Performs background count rate determinations for Ludlum Models 1000, 2000, and 2929 prior to operation in accordance with Section 5.1, Ludlum Models 1000, 2000, and 2929 - Alpha Background Count Rate.

Performs alpha performance checks for Ludlum Models 1000, 2000, and 2929 prior to operation in accordance with Section 5.2, Ludlum Models 1000, 2000, and 2929 - Alpha Performance Check.

Performs beta background count rate determinations for Ludlum Models 2000 and 2929 prior to operation in accordance with Section 5.3, Ludlum Model 2929 - Beta Background Count Rate.

Performs beta performance checks for Ludlum Models 2000 and 2929 prior to operation in accordance with Section 5.4, Ludlum Model 2929 - Beta Performance Check

Ensures calibration facilities meet the requirements of American National Standards Institute (ANSI) N323-1978, Radiation Protection Instrumentation Test and Calibration, for instruments not calibrated on site. This may be satisfied by the calibration sheet statement that the lab meets ANSI N323-1978.

Completes Appendix 1, Instrument Performance Check Logs after the pre-operational performance, or background count rate checks.

Refers servicing of counting instruments to certified calibration facilities, the equipment vendor, or equipment owners when servicing is required.

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5. LIMITATIONS AND PRECAUTIONS

- Prior to use of counting instruments on each shift, the average background count rate shall be determined and performance test conducted.
- Calibration sticker shall be verified to be current before the operation of each instrument.
- Caution must be observed in order to prevent contamination of instruments while placing smears in the counter.
- Prior to use, ensure that all necessary source checks have been performed.
- Equipment warm up times required by the manufactures' specifications shall be met prior to use.

6. PREREQUISITES

HSS

[1] Verify by visual inspection that the calibration due date of the instrument being used has not expired.

[2] **IF** the calibration due date has passed,
THEN refer the instrument to a certified calibration facility, the equipment vendor, or the owner for servicing.

[3] Inspect the instrument for any physical damage that could affect its operation.

[4] **IF** instrument is found to have physical damage that could affect its operation,
THEN:

[A] notify the Subcontractor Site Safety Officer (SSO)

[B] remove the instrument from service

[C] obtain another instrument

[D] go to step [1] above

[5] Obtain the latest Instrument Performance Check Log for the instruments to be used, or make a copy of Appendix 1, Instrument Performance Check Log.

This form will be used to record the performance check for the equipment being used.

7. INSTRUCTIONS

7.1 Ludlum Models 1000, 2000, and 2929 - Alpha Background Count Rate

HSS

[1] Verify that all prerequisite actions have been completed.

[2] Record the following information, for the instrument being used on the Instrument Performance Check Log:

- Type
- Serial number (#)
- Calibration due (date)

[3] **IF** a Ludlum Model 2000 instrument is being used,
THEN perform a battery check.

[4] Ensure that instrument power has been turned on for a minimum of 10 min. before use.

[5] Open the sample drawer and carefully wipe the top of the drawer and planchet area using cotton swabs or Kimwipes® moistened with alcohol.

[6] Place a clean smear on the sample tray with tweezers ensuring the smear remains flat in the sample tray.

[7] Close and lock the drawer to the sample tray.

[8] Set the control switches of the counter as follows:

[A] Set POWER to ON.

[B] Set MINUTE to 1 minute.

[C] Set MULTIPLIER to the x10 position.

[D] Set COUNT MODE to the TIMED position.

[9] Press START/RESET.

The counting lamp will illuminate.

[10] Determine the average background count rate by dividing the total count by 10.

[11] **IF** the average background count rate is less than 1 count per minute (cpm),
THEN record the value in the Background Count Rate column of the Instrument Performance Check Log.

[12] Record the time that the background count rate was taken in the space provided on Instrument Performance Check Log.

7.1 Ludlum Models 1000, 2000, and 2929 - Alpha Background Count Rate (continued)

HSS

[13] **IF** the first average background count rate is equal to or greater than 1 cpm, **THEN** repeat Steps [6] through [13].

[14] **IF** the second average background count rate is equal to or greater than 1 cpm, **THEN** do **NOT** use the instrument and notify the Environmental Restoration Subcontractor Site Safety Officer (SSO).

7.2 Ludlum Models 1000, 2000, and 2929 - Alpha Performance Check

HSS

[1] Ensure that an alpha background count rate has been determined in accordance with Section 7.1.

[2] Obtain a National Institute of Standards and Technology (NIST) certified Th-230 or Pu-239 alpha source for the performance of the Alpha Performance Check.

[3] Verify that the source has a current calibration label.

[4] Ensure that the source value is greater than 1500 disintegrations per minute (dpm).

[5] Record the following information, for the source being used, on the Instrument Performance Check Log:

- Isotope
- Identification (ID) number (#)
- Certified activity (dpm)

[6] **IF** a Ludlum Model 2000 instrument is being used, **THEN** perform a battery check.

[7] Ensure that instrument power has been turned on for a minimum of 10 min. before use.

NOTE *The alpha source must be placed in the sample drawer with the source activity side up.*

[8] Open the sample drawer and carefully place the alpha source, with the source activity side up, in the middle of the sample holder.

[9] Close and lock the sample drawer.

7.2 Ludlum Models 1000, 2000, and 2929 - Alpha Performance Check (continued)

HSS

[10] Set the control switches as follows:

[A] Set POWER to ON.

[B] Set MINUTE to 1 minute.

[C] Set MULTIPLIER to the x1 position.

[D] Set COUNT MODE to the TIMED position.

[11] Press START/RESET and the counting lamp will illuminate.

[12] **WHEN** the counting lamp is no longer illuminated,
THEN record the cpm on the Instrument Performance Check Log.

[13] Determine the percent error of the observed counts compared to the source standard value per the following formula:

$$\% \text{ Error} = \frac{(\text{cpm} / \text{efficiency}) - \text{Certified Activity (dpm)}}{\text{Certified Activity (dpm)}} \times 100$$

Efficiency is obtained from the instrument calibration certification sheet.

[14] Record the percent error on the Instrument Performance Check Log.

[15] Review the results of the Instrument Performance Check prior to use each shift.

[16] Verify the percent error is within the ± 20% range.

[17] **IF** the percent error falls outside the ± 20% range,
THEN:

[A] do **NOT** use the instrument

[B] notify the SSO

[18] Remove the source from the sample holder.

[19] **IF** no other source checks are being performed at this time,
THEN return the source to the designated storage location.

7.3 Ludlum Models 2000 and 2929 - Beta Background Count Rate

HSS

[1] Verify that all prerequisite actions have been completed.

[2] Record the following information, for the instrument being used, on the Instrument Performance Check Log:

- Type
- Serial number (#)
- Calibration due (date)

[3] **IF** a Ludlum Model 2000 instrument is being used,
THEN perform a battery check.

[4] Ensure that instrument power has been turned on for a minimum of 10 min. before use.

[5] Open the sample drawer and carefully wipe the top of the drawer and planchet area using cotton swabs or kimwipes moistened with alcohol.

[6] Place a clean smear on the sample tray with tweezers ensuring the smear remains flat in the sample tray.

[7] Close and lock the drawer to the sample tray.

[8] Set the control switches of the counter as follows:

[A] Set POWER to ON.

[B] Set MINUTE to 10 minutes.

[C] Set MULTIPLIER to the x1 position.

[D] Set COUNT MODE to the TIMED position.

[9] Press START/RESET the counting lamp will illuminate.

[10] Determine the average background count rate by dividing the total counts by 10.

[11] **IF** the background count rate is between 50 and 125 cpm for model 2929
OR between 20 and 70 cpm for model 2000,
THEN record the value in the Background Count Rate column on Appendix 1.

[12] Record the time of the background determination in the space provided on the Instrument Performance Check Log.

[13] **IF** the background count rate is outside the range of 50 to 125 cpm for model 2929
OR 20 to 70 cpm for model 2000,
THEN repeat Steps [6] through [12]

7.3 Ludlum Models 2000 and 2929 - Beta Background Count Rate

HSS

[14] **IF** the background count rate is outside the range of 50 to 125 cpm for model 2929 **OR** 20 to 70 cpm for model 2000 after repeating Steps [6] through [12], **THEN:**

[A] do **NOT** use the instrument

[B] notify the SSO

7.4 Ludlum Models 2000 and 2929 - Beta Performance Check

HSS

[1] Ensure a beta background count rate has been determined in accordance with Section 7.3.

[2] Obtain a NIST certified SrY-90 beta source or another source approved by Radiological Health and Engineering for the Instrument Performance Check.

[3] Verify the source has a current calibration label.

[4] Record the following information, for the source being used, on the Instrument Performance Check Log:

- Isotope
- Identification (ID) number (#)
- Certified activity (DPM)

[5] **IF** a Ludlum Model 2000 instrument is being used, **THEN** perform a battery check.

[6] Ensure that instrument power has been turned on for a minimum of 10 min. before use.

[7] Open the sample drawer and carefully place the beta source in the middle of the sample holder with the activity side up.

[8] Close and lock the sample drawer.

[9] Set the control switches as follows:

[A] Set POWER to ON.

[B] Set MINUTE to 10 minutes.

[C] Set MULTIPLIER to the x1 position.

[D] Set COUNT MODE to the TIMED position.

7.4 Ludlum Models 2000 and 2929 - Beta Performance Check (continued)

HSS

[10] Press START/RESET.

The counting lamp will illuminate.

[11] **WHEN** the counting lamp no longer illuminates,
THEN record the cpm in the Source Count Rate column in the Instrument Performance Check Log.

[12] Determine the percent (%) error of the observed counts compared to the source standard value per the following formula:

$$\% \text{ Error} = \frac{(\text{cpm} / \text{efficiency}) - \text{Certified Activity (dpm)}}{\text{Certified Activity (dpm)}} \times 100$$

Efficiency is obtained from the instrument calibration certification sheet.

[13] Record the percent error on the Instrument Performance Check Log.

[14] Review the Instrument Performance Check Log each shift.

[15] Verify that the percent error is within the ± 20% range.

[16] **IF** the percent error falls outside the ± 20% range,
THEN:

[A] notify the SSO

[B] do **NOT** use the instrument

[17] Remove the source from the sample holder.

[18] **IF** no other source checks are being performed at this time,
THEN return the source to the designated storage location.

7.5 Operation of Ludlum Models 1000, 2000, and 2929 - Alpha-Scintillation Counting Instruments

HSS

[1] Verify that all prerequisite actions have been completed.

[2] **IF** a Ludlum Model 2000 instrument is being used,
THEN perform a battery check.

[3] Ensure that instrument power has been turned on for a minimum of 10 min. before use.

[4] Ensure that the alpha counter has been source checked for the day that it is being used.

7.5 Operation of Ludlum Models 1000, 2000, and 2929 - Alpha-Scintillation Counting Instruments (continued)

HSS

NOTE *One min. counts will be obtained for routine smear counts unless a longer count time is directed by the SSO or Radiological Engineering.*

[5] Set the control switches of the counter as follows:

[A] Set POWER to ON.

[B] Set MINUTE to 1 minute.

[C] Set MULTIPLIER to the x1 position.

[D] Set COUNT MODE to the TIMED position.

[6] Pull the sample drawer open until fully extended and place the smear to be evaluated in the center of the sample holder, activity side up.

[7] Ensure that the sample is as flat as possible to prevent contamination of the detector window.

[8] Carefully close and lock the sample drawer.

[9] Press START/RESET.

The instrument will count for the preset time. At the end of the count time, the instrument readout will display gross counts.

[10] Record the cpm and all required information on the Alpha and Beta-Gamma Contamination Survey Form in accordance with 3-P11-ER-OPS-EMRG-3.1, Performance of Surface Contamination Surveys.

[11] Open the sample drawer and dispose of the smear into an appropriate waste receptacle.

7.6 Operation of Ludlum Models 2000 and 2929 - Beta Smear Counting Instruments

HSS

[1] **IF** a Ludlum Model 2000 instrument is being used,
THEN perform a battery check.

[2] Ensure that the instrument has been turned on for a minimum of 10 min. before use.

[3] Ensure that the dual counter has been source checked for the day that it is being used.

NOTE *One min. counts will be obtained for routine smear counts unless a longer count time is directed by the SSO or Radiological Engineering.*

[4] Set the control switches of the counter as follows:

[A] Set POWER to ON.

[B] Set MINUTE to 1 minute.

[C] Set MULTIPLIER to the x1 position.

[D] Set COUNT MODE to the TIMED position.

[5] Pull the sample drawer open until fully extended and place the smear to be evaluated in the center of the sample holder, activity side up.

[6] Ensure the sample is as flat as possible to prevent contamination of the detector window.

[7] Carefully close and lock the sample drawer.

[8] Press START/RESET.

The instrument will count for the preset time. At the end of the count time, the instrument readout will display gross counts.

[9] Determine the dpm value for the smear using the following formulas:

[A] cpm (net) = cpm gross – cpm background

[B] $$\text{dpm} = \frac{\text{cpm (net)}}{\text{instrument efficiency}}$$

[10] Record the dpm smear value and all information on the Alpha and Beta-Gamma Contamination Survey Form in accordance with 3-P11-ER-OPS-EMRG-3.1.

[11] Open the sample drawer and dispose of the smear into an appropriate waste receptacle.

[12] Repeat Steps [4] through [11] for all smears to be counted.

7.7 Servicing Of Counting Instruments

HSS

[1] Ensure that any calibration facility meets the requirements of American National Standards Institute (ANSI) N323-1978, Standard for radiation protection instrumentation test and calibration procedure.

[2] Refer servicing of counting instruments to any of the following facilities:

- A certified calibration facility
- The equipment vendor
- The equipment owner

8. RECORDS

Management of all records is consistent with 1-77000-RM-001, Records Management Guidance for Records Sources

HSS

[1] Ensure that the original and one copy of the following quality-related records, as appropriate, are transmitted to the Environmental Restoration Program Division Project File Center in accordance with 2-G18-ER-ADM-17.01, Records Capture and Transmittal:

- Instrument Performance Check Log
- Alpha and Beta-Gama Contamination Survey Form

Submission of record copies to the Environmental Restoration Program Division Project File Center satisfies Administrative Records requirements in accordance with 3-21000-ADM-17.02, Administrative Records Screening and Processing.

There are no nonquality records generated by this procedure.

9. REFERENCES

American National Standards Institute (ANSI) N323-1978, Radiation Protection Instrumentation Test and Calibration

DOE/EH-0256T, Radiation Control Manual

DOE Order 5400.5, Radiation Protection of the Public and the Environment

DOE Order 5480.11, Radiation Protection for Occupational Workers

1-77000-RM-001, Records Management Guidance for Records Sources

3-P11-ER-OPS-EMRG-3.1, Performance of Surface Contamination Surveys

2-G18-ER-ADM-17.01, Records Capture and Transmittal

3-21000-ADM-17.02, Administrative Records Screening and Processing

APPENDIX 1

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Instrument Performance Check Log

Instrument
Type _____
Serial # _____
Calibration Due _____

Source
Isotope _____
Activity (DPM) _____
ID # _____

Acceptance Criteria
Percent Error ≤ 20%

Date	Time	Efficiency (cpm/dpm) Note (1)	Source Count Rate (cpm)	Background Count Rate (cpm)	Net Count Rate (cpm) (2)	Observed Activity (cpm) (3)	% Error (≤ 20%?)	Acceptance (Yes/No)	HSS Initials

Note (1) Efficiency is determined during the instruments calibration
Note (2) Net Count Rate = Source Count Rate - Background Count Rate
Note (3) Observed Activity = Net Count Rate ÷ Efficiency

$$\% \text{ Error} = \frac{(\text{cpm} / \text{efficiency}) - \text{Certified Activity (dpm)} \times 100}{\text{Certified Activity (dpm)}}$$